ASTER DEM Development in Mountainous Terrain for Natural Resource Assessments in Afghanistan.

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There are numerous challenges associated with DEM extraction from Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) sensor data in the mountainous terrain of Afghanistan. Currently, the highest resolution, publicly available DEM dataset for Afghanistan is the 3 arc-second (90 m), Shuttle Radar Topography Mission (SRTM) data, which has limited utility beyond macro-scale DEM analysis and mapping. Higher resolution data, 1 arc-second (30 m) data, are more suitable for landform classification, geologic structure analysis, and natural resource assessment applications. The ASTER visible and near infrared sensor (VNIR) system generates along-track stereo images that can be used to develop higher resolution (30 m) DEMs using digital photogrammetry and stereo-auto correlation techniques.

Previous studies demonstrate the ability to derive 30 m DEMs from ASTER for a variety of applications. Few studies focus on regional-scale projects where multiple ASTER DEMs are edge matched and mosaicked. Even fewer have assessed DEMs developed in high mountainous terrain. Our study presents the challenges and solutions associated with regional-scale DEM production in high mountainous terrain, and how terrain factors, slope and the pointing angle of ASTER's VNIR sensor affect the output elevation product.

For this study, 86 absolute DEMs were created and extracted using PCI Geomatica's Orthoengine software. The resultant DEMs exhibited common errors from the stereo-auto correlation process that occurred in image areas corresponding to cloudy and snow covered areas, lakes, steep slope areas, and southeastern facing slopes. As a result of these features, poorly correlated elevation values produced erroneous holes, large pits and spikes in the initial elevation model output.

Preliminary analysis was performed on the slope values of the 90 m SRTM data and the ASTER scene metadata. The results indicate that erroneous elevation values corresponded with steep slopes and scenes collected with high, off-nadir pointing angles. To address these errors, multiple scenes were acquired with low off-nadir pointing angles and overlapping DEMs were produced and mosaicked to fill void areas. In addition, a progressive morphologic filter was applied as a post processing step to remove pits and spikes. These post-processed and mosaicked DEMs produce more accurate and visually appealing elevation models for landform classification, geologic structure analysis, and natural resource assessment applications.